1 GEO 02 – Water

2 Subject Area

Geography

3 Suggested Level

Years 9–10

4 Key Statistical Literacy Competencies

- Data awareness.
- The ability to understand statistical concepts.
- The ability to analyse, interpret and evaluate statistical information.
- The ability to communicate statistical information and understandings.

5 Overview

Water is critical for sustaining life and Australia is the second driest continent on earth after Antarctica. This classroom activity explores the role of water within Australia, its origins, storage, use and value to the economy. In addition, an opportunity is created through the use of CensusAtSchool data to review how household behaviour leads to water savings. The activity makes use CensusAtSchool, the ABS' online learning resource about Australian school students and three ABS publications:

- Year Book Australia 2008 (cat. no. 1301.0)
- Australia's Environment: Issues and Trends, 2007 (cat. no. 4613.0)
- Water Account, Australia, 2004-05 (cat. no. 4610.0).

6 Requirements

- Computer
- Internet connection
- Spreadsheet software program (e.g. Microsoft Excel)
- Calculator
- Pens, coloured pencils, ruler
- Outline map of Australia showing state capital cities (see Attachment, figure 1)

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8 Instructions

Background

Water is a valuable resource. Apart from drinking water and household use, Australians rely on water as an input to almost every industry in the nation's economy particularly agriculture. In the past, Australians have generally thought of water as a free resource. However, drought and water restrictions in many areas of Australia, together with increasing evidence of the adverse effects of increased water use on river health, is changing the way we regard water. It is now widely recognised that taking too much water out of Australia's rivers and groundwater systems can have detrimental economic and environmental consequences. These can include declines in native animal and plant populations (and possible extinctions) and agricultural production caused by reduced availability of water or increased salinity.

Ask students to complete the following activities.

8.1 Is water a renewable or non renewable resource?

Ask the students to define the terms 'renewable resource' and 'non-renewable resource' and provide examples of each.

8.2 What is the Water Cycle?

Ask students to complete **one** of the following activities.

1. Write each of the terms in Table 1 onto a small card. Make several sets of cards according to the number of groups in the class. Divide the class into groups of 5 students. Provide each group with a set of cards containing the words from Table 1. Ask the students to define the terms on the cards assigned to them. Students should then arrange their cards in a correct order to provide an explanation for the water cycle. The group may prefer to create a story with a narrator for this activity.

2. Create an annotated flow chart explaining the operation of the water cycle, using the terms from Table 1 in an appropriate order.

TABLE 1: TERMS USED IN THE WATER CYCLE.

water vapour	run off	ocean
evaporation	transpiration	aquifers
wells/bores	lakes	evapotranspiration
condensation	precipitation	atmosphere
ground water storage	infiltration	water table

3. Create the 'Story of a raindrop' suitable for the upper primary school age group and present it as a narrative, a PowerPoint, a podcast or vodcast. The

story should show the path taken by a single raindrop as it moves through the water cycle.

4. Divide the class into groups and ask them to create a short script for a production 'Story of a Raindrop', suitable for upper primary students. Members of the group could act the part of the raindrop and explain what happens during the water cycle.

5. Use the internet to find a diagram of the water cycle and annotate it with statistics showing the volume of water stored and moving through the water cycle.

8.3 What are the sources of water in Australia?

Australia is the driest habitable continent on earth. Deserts are where permanent vegetation cannot be supported because of one or more factors. Low annual precipitation is one of the most important factors. For example, where precipitation is less than 250 mm per annum, it is difficult to support permanent vegetation..

1. Deserts are areas where average annual precipitation is very low e.g. <250mm. Locate a map showing Australia's average annual rainfall or use the map in the 2008 Year Book Australia. Provide students with a copy of a map of Australia in figure 1 (see attachment) and ask the students to mark the 250mm isohyet on their map.

2. On the map of Australia, using the statistics provided in Table 2, choose an appropriate scale to represent the average annual rainfall of Australian cities as column graphs located over each city.

TABLE 2: AVERAGE ANNUAL RAINFALL AND DAILY TEMPERATURES, SELECTED CITIES.

	Rainfall (mm)	Daily maximum Temperature ºC	Daily minimum Temperature ºC
Sydney	1276.5	22.3	14.4
Melbourne	654.4	20.1	11.2
Brisbane	1194.0	25.3	15.7
Adelaide	563.0	22.1	12.1
Perth	745.3	24.5	12.5
Hobart	576.4	17.2	8.8
Darwin	1847.1	32.1	23.4
Canberra	630.0	19.7	6.7
Alice Springs	325.6	28.8	13.2

Australia's Environment: Issues and Trends, 2007 (cat. no. 4613.0)
Australian Averages are for the standard climate normal period (1971 - 2000) except for Adelaide (1977-2000). Brisbane, Perth, Darwin and Canberra averages are for observations taken at airports, others are at locations in or near the central city.
Source: Bureau of Meteorology, http://www.bom.gov.au, last viewed 3 September 2007.

a) What is the difference between precipitation and rainfall?

b) The average annual rainfall figures are provided for the period 1971-2000 for all cities except Adelaide (1977 - 2000). How is average annual rainfall calculated?

c) Using the map created above, describe the distribution of rainfall in Australia.

d) Why does Canberra have a lower average daily minimum temperature than Hobart?

e) Why does Alice Springs have a lower average daily maximum than Darwin?

f) Hobart has the lowest average daily maximum temperature, but not the lowest average daily minimum. Explain.

g) Alice Springs has the second highest average daily maximum temperature but the fourth highest daily minimum temperature. Explain why this is the case.

h) Using examples from the table explain how distance from the sea and latitude affect rainfall and temperatures in Australia.

i) Use the publication Australia's Environment: Issues and Trends, 2007 (cat. no. 4613.0) to summarise the weather conditions associated with El Nino and La Nina?

8.4 Where is water stored in Australia?

Large dams and farm storages hold water until it is required by households, industries and agriculture.

Dams and farm dams

Go to the website of the Water Resources Observation Network of Australia (WRON) at http://www.wron.net.au/teasers.html and ask students to answer the following questions.

1. Use the Google map interface option on the website and describe the location of dams close to 100% capacity.

2. Identify five dams closest to the school and review their current capacity.

3. Describe the current pattern of dam capacity shown on the map of Australia.

4. How may this pattern change between winter and summer seasons?

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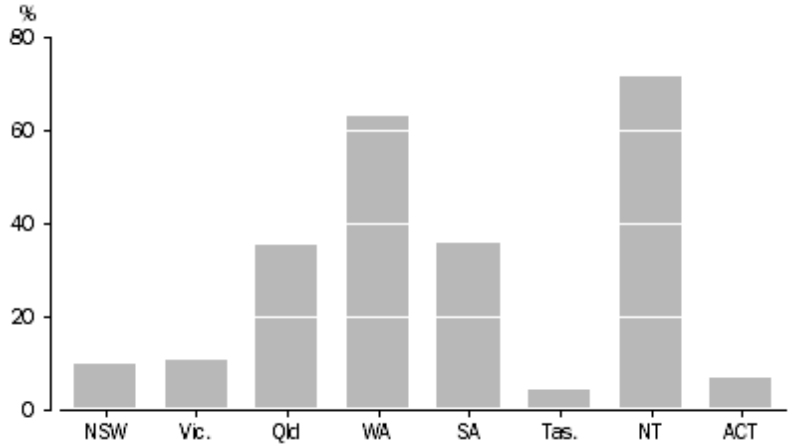
Ground Water

While surface water supplies in dams and reservoirs are usually the main focus when assessing water availability, Australia also has significant groundwater reserves.

Groundwater is water contained underground in geological formations, made up of porous rocks or soils, known as aquifers. Surface water (in rivers) and groundwater can be interconnected as water seeps through riverbeds and percolates down to become groundwater. They can also be interconnected as groundwater surfaces in wetlands or streams due to the removal of deep-rooted (usually native) vegetation.
About 80% of total water consumed in Australia is surface water and about 20% is groundwater.

FIGURE 2: GROUNDWATER AS A PERCENTAGE OF TOTAL WATER USE, BY STATE, 1996-97.



Australia's Environment: Issues and Trends, 2007 (cat. no. 4613.0)
Adapted from: National Land and Water Resources Audit 2001, Australian Water Resources Assessment 2000, Land and Water Australia, Canberra. (cat. no. 4613.0)

1. Which states have the highest percentage of total water use as ground water?

2. Identify the factors that explain why these states have the highest percentage of total water use from groundwater.

3. What are the advantages and disadvantages of water being stored as groundwater?

8.5 Where is water used in Australia?

Study the map in figure 3 (see attachment) showing water consumption in Australia (2004-2005). Comment on the pattern of consumption shown.

8.6 How is water used In Australia?

TABLE 3: WATER CONSUMPTION, 2000-01 AND 2004-05

	2000-2001 Gigalitres(GL)	**2004-2005 Gigalitres(GL)**
Agriculture	14 989	12 191
Forestry and fishing(a)	44	51
Mining	321	413
Manufacturing	549	589
Electricity and gas	255	271
Water supply(b),(c)	2 165	2 083
Other industries	1 102	1 059
Household	2 278	2 108
Total	21 703	18 765

Source: Water Account Australia, 2004-2005 (cat. no. 4610.0)
(a) Includes Services to agriculture; hunting and trapping.
(b) Includes Sewerage and drainage services.
(c) Includes water losses.

Study the statistics about water consumption in Table 3. Answer the following questions:

1. Create a graph to show the pattern of water consumption for the period 2004-05.

2. Comment on the water consumption pattern and relate it to the map above.

3. Calculate the percentage change in water consumption between 2000-01 and 2004-05.

4. With the aid of statistics from the table and those generated in question 3, describe what has happened to water consumption between 2000/01 to 2004/05.

5. Make a list of ways in which your household, your school or your local council has saved water recently.

8.7 How is water used in Agriculture?

1. Ask students to predict which types of agriculture will use most water.

2. Study the table below

TABLE 4: WATER CONSUMPTION AND GROSS VALUE OF IRRIGATED AGRICULTURAL PRODUCTION (2004 -2005)

Agricultural Activity	**Water consumption 2004-2005 Megalitres (ML)**	**Gross Value of irrigated agricultural production, 2004-2005 $million**
Dairy Farming	2 275 603	1 632
Vegetables	455 373	1 761
Sugar	1 269 012	477
Fruit	647 662	1 777
Grapes	717 047	1 314
Cotton	1 821509	908
Rice	630 872	102
Livestock, pasture, grains and other. Livestock Pasture(a) Grains Other Total livestock pasture and grains	 1 035 474 1 927 892 1 162 268 248 659 4 374 293	 367
Nurseries, cut flowers and turf	No data provided	737
Total	12 191 372	9 076

Source: Water Account Australia, 2004-2005 (cat. no. 4610.0 tables 1.23 and 1.26).

a) Ask students to rank the irrigated agricultural production according to its value, from highest to lowest. Beside this list, rank the water consumption from highest to lowest. (For 'livestock, pasture, grains and other' use the Total value.) Identify the 'water hungry' agricultural activities and comment on the rankings observed.

b) Ask students to brainstorm how to economise on water use in agricultural production.

8.8 What can we do?

Ask students to reflect on how they could save water in their everyday lives.

Create a questionnaire from these ideas to survey students in the class and school. For ideas on how to structure the survey go to the ABS CensusAtSchool website.

The final question (Question 40) of the 2008 CensusAtSchool questionnaire, asked students about the actions their household had taken to address the water issue in Australia. Data was collected from Australian students in 2008, when drought had affected several parts of the country and many cities and towns were under strict water restrictions.

Download a sample of 200 from the CensusAtSchool database, using the random sampler

Samples of data may be taken in a number of ways. For example, samples could be taken of different age groups, or by selecting specific postcodes, samples may be taken from each state.

Use MS Excel or other software to create a column graph showing whether households had installed a water tank, installed a water saving shower, were taking shorter showers, were using plugs in sinks, and/or were not wasting water when brushing their teeth.

With reference to the CensusAtSchool data and the results of the survey undertaken within the school, ask students to report on the actions being taken by Australian families to the water issue.

9 Answers

9.1 How is water used in Australia?

The answers to question 3 about percentage change in water consumption are shown in the table below.

TABLE 3: PERCENTAGE CHANGE IN WATER CONSUMPTION, 2000-01 AND 2004-05

	2000-2001 Gigalitres(GL)	**2004-2001 Gigalitres(GL)**	**Percentage Change From 2001-01 to 2004-05**
Agriculture	14 989	12 191	-18.7%
Forestry and fishing(a)	44	51	+15.9%
Mining	321	413	+28.7%
Manufacturing	549	589	+7.3%
Electricity and gas	255	271	+6.3%
Water supply(b),(c)	2 165	2 083	-3.8%

Other industries	1 102	1 059	-3.9%
Household	2 278	2 108	-7.5%
Total	21 703	18 765	-13.5%

Source: Water Account Australia, 2004-2005 (cat. no. 4610.0)
(a) Includes services to agriculture; hunting and trapping.
(b) Includes sewerage and drainage services.
(c) Includes water losses.

11 Glossary

Aquifers
A permeable rock formation that stores and transports groundwater.
Evaporation
The loss of water from the surface of an object to the atmosphere in the form of water vapour (gas)
Evapotranspiration
A major process in the hydrological cycle in transferring water from one place to another. Evapotranspiration is the combined loss of moisture from the earth – from the land and water surfaces such as oceans and lakes (evaporation) and from vegetation (transpiration).
Ground Water
Strictly all subsurface water whether liquid, solid or gas. Groundwater usually means water received from precipitation and stored beneath the surface below the saturated zone of the water table.
Isohyet
Line joining places of the same rainfall.
Precipitation
The process by which water returns from the atmosphere to the surface of the Earth in the form of rain, hail, sleet, snow and dew.
Renewable resource
A resource that will not run out as a result of its use.
Runoff
Water flowing downhill, either across the surface as surface runoff, or beneath the surface as subsurface or groundwater runoff.
Transpiration
Loss of moisture from vegetation
Water Table
Upper part of the saturated zone of the regolith, which is the earth's surface of weathered and unweathered rock.

12 References

(Note: Links to ABS publications are to the most recent release. Previous releases can be accessed by selecting the 'Past & Future Releases' tab.)

Year Book Australia, 2008 (cat. no. 1301.0)
http://www.abs.gov.au/AUSSTATS/abs@.nsf/MF/1301.0/

Australia's Environment: Issues and Trends, 2007 (cat. no. 4613.0)

http://www.abs.gov.au/AUSSTATS/abs@.nsf/productsbyCatalogue/22DF603EA8680B40CA256A8A00836F8A?OpenDocument

Water Account, Australia, 2004-05 (cat. no. 4610.0)
http://www.abs.gov.au/ausstats/abs@.nsf/mf/4610.0

13 Feedback

To provide any feedback regarding this activity, please contact ABS Education Services on 1800 623 273 or email education@abs.gov.au.

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